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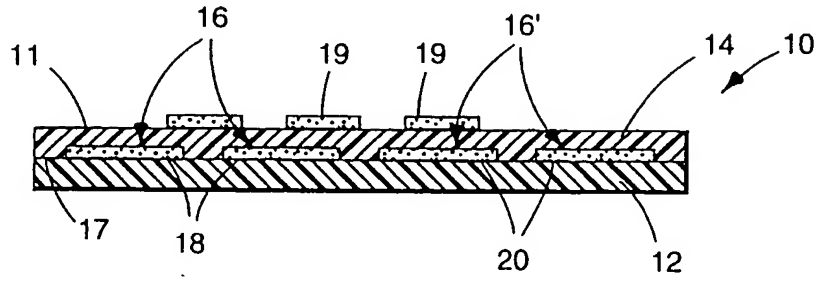

(57) Abstract: A durable and flexible card using a controlled blend of thermoplastic polyester elastomer and copolyester is disclosed. The card has utility as driver licenses, identification or security cards. The blend can be used as a card component or in combination with other laminates. A method for making such cards is also disclosed.

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DURABLE SECURITY CARD AND METHOD FOR MAKING SAME

Technical Field

The present invention relates to a durable and flexible card, such as an identification card or driver's license, and methods for making such cards.

Background of the Invention

United States Patent No. 5,688,738 (Lu) discloses a typical security card and an "over-the-counter" or "desk top" method for making such security cards. This type of security card includes a backing, a cover layer, and a security image located between the backing and the cover layer. Despite the general satisfaction with these types of cards, there has been a desire to improve certain properties of the cards. For example, the card can crack in long-term use. It is therefore desirable to produce a security card that exhibits minimal cracking in long-term use.

Summary of the Invention

Applicants have discovered a cracking problem with cards, such as those disclosed in Lu (the '738 patent), in long-term use. Cracking may occur in as few as 2,000 flexes, as described below in Table A. The present invention minimizes or solves the cracking problem for many applications. The material of the present invention provides a durable laminate layer usable either by itself or in combination with other layers or components for cards. The material is sturdy enough to resist cracking when repeatedly flexed.

The inventive material blends amorphous copolyester with a thermoplastic polyester elastomer to provide a card layer. The blended layer may either be used alone as a card, or can be laminated to another layer, such as one made of polyvinyl chloride (PVC), to provide a card usable for security cards. This invention also includes a method for making cards made of or including the blended layer.

In one embodiment, the laminate includes a cover layer and a backing layer with an image located between the layers. The cover layer is preferably a transparent film, thus allowing an observer to view the image.

Another embodiment of the invention includes a card comprising the inventive blend of copolyester and thermoplastic polyester elastomer.

Brief Description of the Drawings

The invention will be further explained with reference to the drawings, wherein:

Figure 1 is an enlarged cross-sectional view of an embodiment of the blended layer alone as a card component of the present invention;

Figure 2 is an enlarged cross-sectional view of an embodiment of the security card of the present invention;

Figure 3 is an enlarged cross-sectional view of another embodiment of a security card of the present invention wherein a skin layer is included;

Figure 4 is an enlarged cross-sectional view of another embodiment of a security card of the present invention including a cover sheet having plano-convex lens elements; and

Figure 5 is an enlarged cross-sectional view of another embodiment of a security card of the present invention wherein the backing layer is between two cover layers.

Detailed Description of the Invention

The present invention relates to a novel material used in cards. More particularly, the present invention relates to material used in making durable flexible cards and the methods used to manufacture the cards. The durable card component of the present invention is a blend of amorphous copolyester (CoPET) and a thermoplastic polyester elastomer (TPPE), and may be used by itself, or laminated to one or more additional card components made of, for example, PVC, or used with other coatings, layers, or the like. The blended material addresses the need for durable security cards

with the flexibility necessary to avoid the cracking associated with some conventional security cards. A layer of amorphous copolyester may be laminated to one or both sides of the blended layer, if desired.

In one embodiment of a multiple-layer card, a security card of the invention consists of a backing layer, a cover layer, and a security image. The backing layer comprises either PVC or a blend of amorphous copolyester and thermoplastic polyester elastomer on at least its first (inner) side. The cover layer comprises the other of either PVC or a blend of amorphous copolyester and thermoplastic polyester elastomer on at least its first (inner) side. The first side of the backing layer is laminated to the first side of the cover layer. The security image is located between the backing and the cover layer, and the backing and the cover layer are laminated together without an intermediate adhesive layer. The image comprises a dye diffused into the surface of the PVC layer. The card may further comprise an optional secondary image on the outer surface of the cover layer and/or the outer surface of the backing. The backing layer may be pigmented with an opacifying agent or made translucent as desired.

In another embodiment of the present invention, the security card has a layer of PVC, which may be transparent or comprise pigment such as titanium dioxide (TiO_2).

The card component of the present invention will first be described as a blended component useful itself as a card. Next, it will be described in a multiple-layer card in which the card includes a PVC cover layer and a blended amorphous copolyester and thermoplastic polyester elastomer backing layer (although those components could be reversed so that the cover layer is made of the blended material of the invention and the backing layer is made of PVC). The invention described herein is the use of the blended composition as a card component to produce a durable and flexible card, including security cards.

I. Card Components.

An illustration of one embodiment of the card of this invention is shown in Fig. 1, and the components of that and other embodiments are described individually and together below.

A. Blend Alone as a Card Component.

In accordance with this invention, a card can comprise a blend of amorphous copolyester and thermoplastic polyester elastomer. This composition provides the durability, flexibility, and sufficient sturdiness to resist the repeated flexing of typical cards in use.

It is preferable that the copolyester used as a card component be amorphous. Such material does not exhibit a well-defined melting point as determined by Differential Scanning Calorimetry (DSC). A suitable example of commercial amorphous copolyesters that can be used include a blend of CoPET and polycarbonate currently available from Eastman Chemical Company, Kingston, Tennessee under the designation EASTALLOY™ DA003, which has a glass transition temperature ("Tg ") of about 112°C. Another example of a suitable copolyester (CoPET) is also currently available from Eastman Chemical Company, Kingston, Tennessee under the designation EASTAR™ PETG 6763, which is believed to comprise cyclohexanedimethanol, ethylene glycol, and terephthalic acid, and has a Tg of 80°C. EASTAR™ PETG 6763 is available from vendors in film and resin form. Both EASTALLOY™ DA003 and EASTAR™ PETG 6763, which have been found to be suitable for use in the present invention, have been found not to exhibit a well-defined melting point, and are also considered herein to be amorphous.

The thermoplastic polyester elastomer suitable for this invention exhibits flexibility, high flex fatigue resistance and an ease of processing when combined with CoPET. Typically, TPPEs such as those currently commercially available from DuPont Company, of Wilmington, Delaware, (an example of which is DuPont® HYTREL® 4056), have been found to be suitable for use in the present invention. HYTREL® 4056 is believed to comprise block copolymers consisting of a hard segment of polybutadiene terephthalate and a soft segment based on long-chain polyether glycols. HYTREL® 4056 is an extrusion grade, low modulus (62 MPa) elastomer. The processing window for HYTREL® 4056 is between 177°C and 260°C (350°F and 500°F), making it compatible with the extrusion requirements of a CoPET such as PETG 6763.

To improve the flexural strength of the security card, the ratio of the blend of CoPET (such as PETG 6763) and TPPE (such as HYTREL® 4056) should be carefully controlled and is preferably between more than about 50 and less than about 80 weight percent CoPET to between more than about 20 and less than about 50 weight percent TPPE. A preferred ratio is between 55 and 75 weight percent CoPET to between 25 and 45 weight percent TPPE. A more preferred ratio is approximately 70 weight percent CoPET to approximately 30 weight percent TPPE. The unexpected results associated with the improved resistance to cracking of the inventive card are described below in Examples 1 through 10.

Figure 1 is an embodiment of the present invention wherein the blend alone is used as a card component **60**. The card component **60** may be either translucent or opaque, as desired. In some instances, the card component **60** contains dyes or pigments to provide a desired background color or degree of opacity. The background color gives the desired visibility for an image **19** and a desired appearance to card component **60**. The card component **60** commonly contains a pigment such as titanium dioxide (TiO_2) to provide an opaque white background to improve legibility and conspicuity of image **19**. It is preferable to use the minimum pigment loading necessary to color the backing in order not to diminish the desired properties of the backing layer. One way to provide a white backing, for example, is to blend a PETG material with another PETG material that has been pigmented with a known quantity of, for example, titanium dioxide. For example, a blend of EASTAR™ PETG 6763 and EASTAR™ PETG 6763COO22 can be provided to attain the desired opacity. EASTAR™ PETG 6763COO22 is simply EASTAR™ PETG 6763 pigmented with 22% titanium dioxide, and is also available from Eastman Chemical Products Company of Kingsport, Tennessee. The weight percent of the pigmented CoPET (such as PETG 6763COO22) in the PETG/TPPE blend is preferably less than 20 percent. The weight ratio of PETG 6763 and PETG 6763COO22 in the overall PETG/TPPE blend is more preferably between 85:15 and 95:5, and most preferably between 88:12 and 94:6.

When the blend is used as a single card component, the thickness is typically between about 675 and about 825 micrometers (0.027 and 0.033 inches) thick as specified in American National Standard ANSI X3B10.6 dated February 28, 1997.

Images such as pre-printed symbols, logos, decorative designs, covert and overt security features, and/or information common to a group of related cards on either or both of its designated first or second surfaces.

B. Multiple-Layer Constructions.

As noted above, the inventive blend can be used together with other materials and layers, some of which are described below.

1. Cover Layer.

The cover layer **14** of the present invention has two major surfaces **11** and **17** as illustrated in Figure 2. First major surface **11** is usually the (outermost) protective cover of the security card. Second major opposing surface **17** is preferably bonded to the backing layer **12** of the inventive card component **10**. Cover layer **14** is typically made of a film that is preferably more flexible than the backing layer **12**.

Suitable materials for use as cover layer **14** are preferably UV stabilized, heat resistant, durable, and have good optical clarity, or have at least some of these properties. Suitable film for use as cover layer **14** in the present invention include polymers or copolymers of unplasticized PVC, and adhesive-coated films, such as polyethylene terephthalate (PET), polyolefin or polycarbonate. Cover layer **14** is preferably a layer of extruded unplasticized PVC film. PVC films such as those available from Klockner-Pentaplast of America, Inc., of Gordonsville, Virginia under the designation PENTAPRINT™ PR180/98 have been found to be suitable for use in the present invention. As noted above, the cover layer could instead be the blended material of the invention, in which case the backing could be made of the PVC material just described.

The cover layer **14** of the invention is preferably between 25 micrometers and 380 micrometers (0.001 inches and 0.015 inches) thick, more preferably between 100 micrometers and 300 micrometers (0.004 inches and 0.012 inches) thick and most preferably between 150 micrometers and 250 micrometers (0.006 inches and 0.01 inches) thick. Although optional, cover layers usable for the present invention are preferably receptive to inks, such as thermal mass transfer, thermal dye transfer

ribbons, toner, screen printing ink, flexographic ink, inkjet inks, and the like. The first surface of the cover layer of the present invention should also be receptive to a hard coating to provide scratch or scuff resistance. The cover layer **14** can be laminated to backing layer **12** in the manner described below.

2. Backing Layer.

The novel backing layer **12** is preferably a blend of amorphous copolyester and thermoplastic polyester elastomer as discussed above.

When used as a backing layer, the amorphous material, because it does not exhibit a well-defined melting point, is one that when blended with the TPPE will not substantially crystallize under the conditions used to laminate it to the PVC of the other sheet. The backing layer may be bonded to the PVC cover layer **14**. The unexpected results associated with the improved resistance to cracking of this embodiment of the invention are described below in Examples 9 and 10.

As stated above, the backing layer **12** may be either translucent or opaque, as desired. Backing layer **12** may have pre-printed symbols, logos, decorative designs, covert and overt security features, and/or information common to a group of related cards on either or both of its designated first (intended to be visible through cover layer **14**) or second surfaces (intended to be visible on the back side of card **10**).

In many instances, backing layer **12** is considerably thicker and less flexible than cover layer **14**, because it is intended to provide a major proportion of the desired rigidity and strength of an assembled card **10**. For example, conventional credit cards are typically between about 675 and about 825 micrometers (0.027 and 0.033 inches) thick. Suitable backings of security cards made according to the invention are between about 500 and about 550 micrometers (0.02 and 0.022 inches) thick, and cover layers of between about 175 and about 250 micrometers (0.007 and 0.01 inches) thick, as specified in American National Standard ANSI X3B10.6 dated February 28, 1997.

Backings and cover layers of other thicknesses may be used in accordance with the invention. Cover layer **14** may be optimized to protect security image **16** from tampering and wear while permitting it to be readily inspected and read. Cover layer **14** is typically optimized to maintain its clarity, transparency, color, and

appearance under the conditions to which card **10** is subjected, for example, abrasion and wear.

3. Other Components.

A security image **16** may be located within the card, and is protected from wear as well as tampering attempts and is accordingly referred to herein as a "security image." To improve the tamper resistance and to facilitate verification or authentication of cards **10** of the invention, security image **16** may comprise, or if desired consist of, validation marks or areas **20** designed to provide a visually detectable indication of tampering. This is sometimes referred to as a validation feature. Illustrative examples include pearlescent particles in a transparent binder, holograms, microstructured surfaces providing special optical effects such as holographic images or diffractive effects, and other similar effects. Validation marks **20** may be applied by a number of techniques, depending upon the requirements of the chosen validation mark, for example, printing process, or by any of several known processes to apply electronically recorded or computer generated graphics. Bar codes can be applied to provide security, identification, or for other desired effects.

Security image **16** can be made of one or more of a variety of graphic materials sealed between backing **12** and cover layer **14**. Security image **16**, typically bearing some information specific to the individual card (for example, a person's name, birth date, personal characteristics, or employee number) is applied to the inner surface of cover layer **14** or backing **12** at the time of assembly of card **10**. For instance, images **18** consisting of dye diffused onto the surface of the PVC member prior to lamination to the amorphous copolyester or blended copolyester and elastomer member can be used. Thermal dye transfer ribbons currently available from Imperial Chemical Industries, Inc. of Wilmington, DE (ICI) under the designation OLMEC™ Catalog No. 202458, can be used for this purpose.

If desired, one or more magnetic stripes can be incorporated into security cards of the invention, typically embedded into or laminated onto the back surface of the backing. Commercially available magnetic stripe materials sold for such uses typically have a thermal adhesive applied to the backside of the stripe and have been observed to provide satisfactory adhesion to the PVC, amorphous copolyesters or

blend of amorphous copolyester and thermoplastic polyester elastomer disclosed herein. Similarly, electronically interactive circuits can be incorporated in cards of the invention to provide "smart" cards that may be interrogated by contact with a reader, or by electromagnetic (contactless) coupling. It is contemplated that incorporation of such circuits most preferably will be done at the point of injection molding of the blended composition though an integrated circuit could be placed between card components before lamination, or at any other suitable point in the manufacturing process.

An optional hardcoat layer, such as urethane acrylate, may be coated on the first major surface of the cover layer or the backing as protective film for scuff and abrasion resistance.

In some instances when the backing layer is the blended copolyester and elastomer as disclosed in the present invention, a thin layer of transparent PVC may be laminated to the back surface of the backing. Incorporation of pigments in amorphous copolyester (or in PVC when that is used as the backing) may tend to increase the susceptibility of the material to soiling and wear. The unpigmented layer can act as a sheathing to enhance the card's resistance to soiling and wear. If a sheathing layer is used it is preferably of a material that will adhere directly to the backing, for example, PVC to an amorphous copolyester/elastomer backing, or amorphous copolyester/elastomer to a PVC backing, or vinyl chloride/vinyl acetate copolymer to a PVC backing.

C. Other Embodiments.

Figure 3 is another embodiment of the present invention wherein security card **10'** comprises backing layer **12** with optional skin layers **13** and **15** laminated to first and second sides of backing layer **12**. Skin layers **13** and **15** as shown in this embodiment may be used as an adhesion-enhancing layer to the cover film, such as PVC. Amorphous copolyesters such as PETG 6763 are suitable for use as skin film in the present invention (see above discussion of blend alone as card component of Fig. 1). An advantage of using amorphous copolyesters for the skin layer is its compatibility with the amorphous copolyester/elastomer blend of the backing layer **12**.

Fig. 3 illustrates the addition of skin layers to the embodiment as described with reference to Fig. 2.

In some instances, the security card layers are bonded together with an intermediate adhesive. Suitable adhesives for use in this invention include both pressure sensitive adhesives (PSA) and hot melt adhesives. Adhesives may not be desirable, however, because they can render the card susceptible to tampering due to the effect of heat or cold on the adhesive bond.

Figure 4 shows another embodiment of the invention wherein security card **30** comprises backing **32**, cover layer **34**, and security image **36**. Cover layer **34** is of the type disclosed in U.S. Pat. No. 5,254,390 (Lu), and is made up of a microstructured outer layer **40** with an array of hemispheroidal lens elements and inner layer **38**. Outer layer **40** is made of a material in which the desired lens elements can be formed, for example, curable urethane acrylate resin. Inner layer **38**, in accordance with the invention is made of either PVC or amorphous copolyester/elastomer blend, to which outer layer **40** is adhered either with or without an intermediate adhesive. If skin layers **33** and **35** are used, they are preferably positioned as illustrated in Fig. 4.

When cover layers with such lens elements are used, security image **36** may be designed to function with the lens elements. For instance, in addition to images of thermally transferred dye **42**, security image **36** might include a material with specularly reflective properties **44**, for example, liquid crystal polymer, multi-layer high index dielectric coatings, or microstructured total internal reflectance material.

Card **10** may further comprise an additional image **19** on the outer surface of cover layer **14** if desired. In other embodiments, the additional image, referred to herein as a "secondary image," may be formed on the outside of the cover layer or backing. The secondary image may be for decorative purposes, may present useful information, may provide means for verifying authenticity of the card or other purposes not disclosed herein. For instance, an image might be printed on the outer surface of the cover layer, a hologram may be formed on or applied to the cover layer, or other card locations as desired. Secondary images may be exposed on the cover layer or backing, or may be covered, for example, by a security laminate such as CONFIRM™ Brand Retroreflective Security Laminates from Minnesota Mining and

Manufacturing Company of St. Paul, Minnesota (3M). Fig. 4 shows an illustrative embodiment with secondary image **46** on surface of backing **32**. The secondary image may be human readable and/or machine-readable, as can the security image.

Another embodiment of the invention is shown in Fig. 5 wherein security card **50** comprises backing **52**, cover layer **54**, and security image **56**. Cover layer **54** is wrapped around backing **52** to cover both sides thereof. Typically the edges of the card will be die cut after lamination as shown by the hash line **59** on Fig 5. Alternatively, two separate pieces of cover layer material, one applied to one side of backing **52** and one applied to the opposite side, could be used. Such embodiments provide more available image area, thus providing more options to issuing authorities. For instance, human readable information and tamper-resistant images might be placed on one side of the card and machine-readable features, such as bar codes, infrared or ultraviolet legends, and other similarly functional information, might be placed on the other side.

II. Method of Making a Security Card.

A preferred method of manufacturing the security card of this invention is to prepare the pigmented amorphous copolyester resin separately, add the predetermined amount of thermoplastic polyester elastomer resin, blend and extrude the film at a desired thickness. The PVC layer is then laminated to the extruded blend of amorphous copolyester and thermoplastic polyester elastomer, preferably without intermediate adhesive.

The novel blend of amorphous copolyesters and thermoplastic polyester elastomer has good adhesion to PVC at relatively low lamination temperatures or pressures, or both. A typical process condition could be temperatures of between about 120°C and about 170° C for times of less than about 1 minute, sometimes less than about 40 seconds. This advantage enables an operator to make the card on a desk laminator such as those available from Thermal Laminating Company of Evanston, Illinois, under the designation 5500HR. In some instances, higher temperatures or longer lamination time may be required when laminating PVC to the blend of amorphous copolyester and thermoplastic elastomer. Suitable lamination temperatures,

times, and pressures for specific materials can be readily determined by routine experimentation.

To position an image between the layers, an image can be formed on the first surface of the PVC film using conventional processes. This image forming process is performed before lamination as described above. The layers (PVC and blended film) are then laminated as described above.

In instances where a skin layer is desired, an extruded film of amorphous copolyester is used to wrap around the blended layer of amorphous copolyester and thermoplastic polyester elastomer. A PVC layer is then positioned on the construction and laminated as described above.

EXAMPLES

The invention will be further explained by the following illustrative examples that are non-limiting. Unless otherwise indicated, all parts and percentages are by weight. Two examples involving conventional card materials will be described first, followed by examples 1 through 10, which demonstrate the cards of the invention. Accelerated aging, as used in the Examples below, simulates the performance of the cards after several months of actual aging. The data below reflect an average of at least two samples for each category.

Test Methods

The following test methods were used to determine the suitability of the security cards of the present invention, and to compare their performance to security cards such as those disclosed in U.S. Pat. No. 5,688,738 (Lu).

1. **Flexure Test:** Cards (approximately 750 micrometers (0.03 inches) thick) were die cut to standard credit card size (about 85 mm in length and 53 mm in width) and subjected to repeated bending stress. The flexure testing equipment used was a Model SCF 2300 Flexion test system, manufactured by Muhlbauer High Tech International, Germany. Cards were subjected to flex bending over the short side of card with the bending axis parallel to the length (85 mm) of the card, at approximately 40 cycles per minute. For multiple-layer constructions, the cards

were placed with the blended component side up during testing. Each flex bending sequence contracted the space between the jaws of the testing equipment from 53 mm to 45 mm, and then back to 53 mm. When the card surface exhibited cracks, the approximate number of flex cycles was recorded. A card crack is defined as a single fracture of 13 mm in length, or a combination of five or fewer fractures less than 13 mm in length, is observed according to American National Standard ANSI NCIT-322. If the number of flexes is shown in Table 1 to have been greater than a given number (indicated with the sign ">"), it indicates that the test was stopped after the specified number of cycles with no cracks noted. If the number is an approximation (indicated with the sign "~"), it indicates that the card had cracked at about the specified number of flexes when the test was stopped.

2. **Card Rigidity Test:** Cards of the size described in the Flexure Test above were inserted and removed, or swiped into Automatic Teller Machine (ATM) card readers. The ATMs used were NORWEST® (now Wells Fargo®) Bank Instant Cash Machines such as DIEBOLD® 1064ix and 1074ix made by DIEBOLD Incorporated of Canton, Ohio.

Comparative Example A

This example illustrates the durability and flexibility of conventional security cards made of amorphous copolyester, laminated to PVC without an intermediate adhesive, as disclosed in U.S. Pat. No. 5,688,738 (Lu).

A 550 micrometer (0.022 inch) thick film of white amorphous polyester, PETG 6763 from VPI Inc., Sheboygan Falls, Wisconsin, was laminated to a 200 micrometer (0.008 inch) thick polyvinyl chloride (PVC) cover layer, PENTAR™ PR 180/98 from Klockner Pentaplast of America, Inc., Gordonsville, Virginia. A microstructured layer with an array of hemispheroidal lens elements made of UV curable urethane acrylate, as disclosed in U.S. Patent No. 5,254,390 (Lu) was coated onto the cover layer. The PVC with lens coating is designated by 3M as "Direct Image Receptor Film," or "DIRF." The laminates, with the smooth side of the cover layer laid on top of the backing layer, were placed in a 3M Copoly carrier (part number 75-0500-1428-3) and laminated, using a desktop laminator (such as one available from Thermal Laminating Company under the designation model 5560) at temperatures of 138°C at the front

heating zone and 157°C at the rear heating zone. The total residence time in the laminator was approximately 40 seconds between the front and rear zones. The laminate was removed and allowed to cool. The film was cut into nominal credit card size (85 mm x 53 mm) and flexed according to the Flexure Test. Some of the cards were flexure-tested without aging, and some cards were aged for 1 week at 65.6°C (150°F) before testing, as shown in Table A. Unaged cards cracked at approximately 20,000 flex cycles, while aged cards displayed cracking in approximately 2,000 flex cycles.

Comparative Example B

This example illustrates the use of a conventional impact modifier blended into amorphous copolyester for the backing layer.

A 550 micrometer (0.022 inch) thick film of impact-modified white amorphous polyester, containing 7.5 percent by weight of PARALOID EXL 2691 impact modifier, available from Rohm and Haas Company of Philadelphia, Pennsylvania, and 92.5 percent by weight of PETG 6763, was obtained from Eastman Chemical Company of Kingsport, Tennessee. This film was used as the backing layer. A 200-micrometer (0.008 inch) thick polyvinyl chloride film, PENTAR™ PR 180/98 from Klockner Pentaplast of America, Inc., Gordonsville, Virginia, was used as the cover layer. A microstructured layer with an array of hemispheroidal lens elements made of UV curable urethane acrylate as disclosed in U.S. Pat. No. 5,254,390 (Lu) was coated on the cover layer. The smooth side of the cover layer was laminated to the backing layer using a desktop laminator (of the type available from Thermal Lamination Corporation under the designation model 5560) with a temperature of 138°C at the front heating zone and 157°C at the rear heating zone for approximately 40 seconds. The laminate was removed and allowed to cool. The laminate was then cut into nominal credit card size (85 mm x 53 mm) and tested according to the Flexure Test. Some of the cards were flexure-tested without aging, and some cards were aged for 1 week at 65.6°C (150°F) before testing, as shown in Table A. Unaged cards cracked in approximately 8,000 flex cycles while aged cards displayed cracking in approximately 2,000 cycles.

Table A

Example	Card Type	Flex Cycles Before Cracking (Unaged)	Flex Cycles Before Cracking (Aged)
A	CoPET	~20,000	~2,000
B	CoPET with Impact Modifier	~8,000	~2,000

Examples 1 through 8

These examples illustrate the use of a blend of amorphous copolyester and thermoplastic polyester elastomer in accordance with the present invention. Some of cards 1 - 8 were tested before aging while some were aged 1 week at 65.6°C (150°F) before testing, as shown in Table 1 below.

An opaque mixture of amorphous copolyester resin having 91% by weight of EASTAR™ PETG 6763 and 9% by weight of TiO_2 pigmented EASTAR™ PETG 6763COO22 was premixed for use in these Examples. This mixture (CoPET) was then compounded with varying amounts of HYTREL® 4056 (TPPE). In particular, the ratios compounded were 0, 10, 20, 22, 25, 30, 40, and 50 percent by weight of TPPE for Examples 1, 2, 3, 4, 5, 6, 7, and 8, respectively. These mixtures were then dried overnight at 65.6°C (150°F) and extruded at a thickness of about 750 micrometers (0.03 inches). The extruded films were cut into nominal credit card sizes. Some of each set of the cards were tested before aging, and some were aged for 1 week at 65.6°C (150°F), as indicated in Table 1. The samples were then subjected to the Flexure Test.

The cards were also subjected to the Card Rigidity Test to determine whether the card samples were usable without buckling or twisting, as would normally be required in use. The results are also detailed in Table 1. Cards having TPPE ratios of 50 percent or greater were deemed too flexible for use as security cards because they buckled and twisted in the Card Rigidity Test.

Table 1

Example	Composition of Blended layer	Thickness of Blended Layer	Flex cycles to crack		Swiping	Inserting
	(CoPET/TPPE)	(μm)	Unaged	Aged		
1	100/0	750	~21,000	~2,600	OK	OK
2	90/10	750	>120,000	~8,000	OK	OK
3	80/20	775	>120,000	~14,000	OK	OK
4	78/22	750	>120,000	~50,000	OK	OK
5	75/25	750	>120,000	~50,000	OK	OK
6	70/30	775	>120,000	>130,000	OK	OK
7	60/40	800	>120,000	>130,000	OK	OK
8	50/50	750	>120,000	>130,000	Twisted	Buckled

Examples 9 and 10

These examples illustrate the use of amorphous copolyester and thermoplastic polyester elastomer blends of the present invention with a cover film of PVC. The layer of PVC was laminated to the inventive blend to illustrate an embodiment of the invention having multiple layers. The results are shown in Table 2 below.

An opaque mixture of amorphous copolyester resin having 91% by weight of EASTAR™ PETG 6763 and 9% by weight of TiO_2 pigmented EASTAR™ 6763COO22 was premixed for use in these Examples. This mixture (CoPET) was then compounded with 30 percent weight ratio of HYTREL® 4056 (TPPE). This mixture (CoPET/TPPE) was then dried overnight at 65.6°C (150°F). Another mixture of 91% by weight of EASTAR™ PETG 6763 and 9% of TiO_2 pigmented EASTAR™ 6763COO22 without TPPE was also dried overnight at 65.6°C (150°F). The two mixtures were co-extruded into a two-layer film of 450 micrometers (0.018 inches) of the blend CoPET/TPPE and 100 micrometers (0.004 inches) of CoPET. A layer of 200 micrometers (0.008 inches) PVC film, PENTAR™ PR180/98 from Klockner

Pentaplast of America, Inc., Gordonsville, Virginia, was laminated to the 550 micrometers (0.022 inches) coextruded film of CoPET and CoPET/TPPE. Some of the laminated films were cut into typical credit card sizes (85 mm x 53 mm) and subjected to the Flexure Test. Some of the cards were tested after they had been aged, and some were tested without aging. In Example 9 the cards were tested with the PVC side facing up, while in Example 10 the CoPET/TPPE side faced upwards.

Table 2

Example	Composition of Blended layer		Thickness of Layers	Flex cycles to crack	
	(CoPET/TPPE)	PVC side	(μm)	Unaged	Aged
9	70/30	Up	750	>1,000,000	>300,000
10	70/30	Down	750	>500,000	>300,000

Summary

Tables 1 and 2 illustrate that the novel backing of the security card of the present invention solves the cracking problem associated with the use of some conventional security cards. A surprising and unexpected effect of the present invention is that a range has been determined wherein the cards are both rigid yet flexible enough to withstand repeated flexing required for optimum card performance. That is, Table 1 illustrates that the typical backing used in security cards is brittle and cracks too easily in use if the amount of HYTREL® 4056 in the blend of CoPET/TPPE is less than 20%. It also illustrates that a blend having more than 50% HYTREL® 4056 in the CoPET/TPPE blend typically results in a card that is too flexible for use in the cards of the present invention. It further illustrates that the number of flexes before cracking is maximized when the amount of HYTREL® 4056 in the blend is more than about 20% and card insertion and/or swiping is maximized when the amount of HYTREL® 4056 in the blend is no greater than 50%.

What is claimed is:

1. A card component, comprising a blend of amorphous copolyester and more than about 20 percent and less than about 50 percent thermoplastic polyester elastomer.

2. A card, comprising:

a) the card component of claim 1; and

b) a card component comprising polyvinyl chloride.

3. The card component of claim 1 or the card of claim 2, wherein the blend consists essentially of more than about 20 percent to less than about 50 percent thermoplastic polyester elastomer, and about 50 percent to about 80 percent amorphous copolyester.

4. The card of claim 2 wherein the first and second card components are laminated together without an intermediate adhesive layer.

5. The card of claim 2 wherein the first and second card components are laminated together with an intermediate adhesive layer.

6. The card of claim 2 wherein an image is located between the first and second card components.

7. The card component of claim 1, wherein images are located on at least one outer surface of the card.

8. The card of claim 2, wherein images are located on one or both the outer surfaces of the card components.

9. The card of claim 2, wherein visible images are located under a transparent or translucent layer of one or both outer surfaces of the card components.

10. The card component of claim 1 wherein said amorphous copolyester is a copolymer of ethylene glycol, cyclohexanedimethanol, and terephthalic acid.

11. The card component of claim 1 wherein said thermoplastic polyester elastomer is a copolymer of polybutadiene terephthalate and polyether glycol.

12. The card of claim 7 wherein said card is between about 675 and about 825 micrometers thick.

13. The card component of claim 1 or the card of claim 2 in combination with a cover layer comprising lens elements protruding from the surface thereof.

14. The card component of claim 2 further comprising at least one secondary image on the outer surface of at least one of the cover layer and the backing.

15. The card component of claim 2 wherein the secondary image is located under a transparent protective layer.

16. A method for making a card, comprising the steps of:

a) providing a first card component having a first major surface comprising polyvinyl chloride;

b) providing a second card component having a first major surface comprising a blend of an amorphous copolyester and thermoplastic polyester elastomer; and

c) laminating the first surface of said second card component to the first surface of first card component to seal the image and laminating the first card component to the second card component substantially without causing said blended copolyester/elastomer to crystallize.

17. The method of claim 16 wherein the steps further includes forming at least one image on at least one major surface of the card.

18. The method of claim 16 wherein at least one of the first card component and the second card component is transparent such that the image is visible therethrough.

19. The method of claim 17 wherein the temperature of said first side of said first card component and the temperature of said first side of said second card component is heated to between about 120°C and 170°C.

20. The method of claim 17 wherein said heat or pressure are applied for less than about 1 minute.

21. The method of claim 17 wherein said applying of heat or pressure is performed with a desktop type laminator.

22. The method of claim 17 further comprising forming a secondary image on the outer surface of at least one of said first card component or said second card component.

23. The method of claim 17 wherein the secondary image is located under a protective transparent layer.

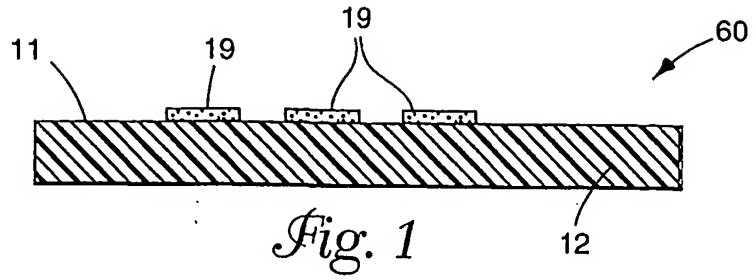

Fig. 1

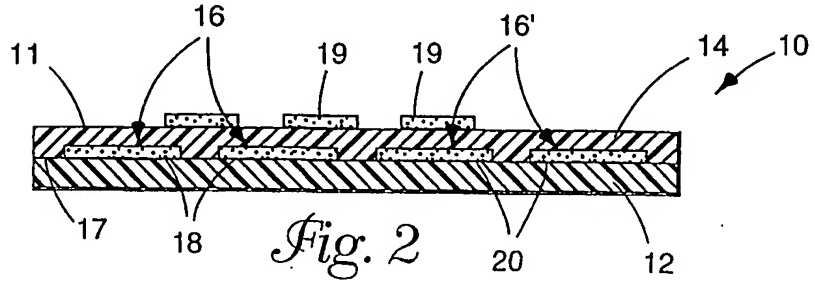

Fig. 2

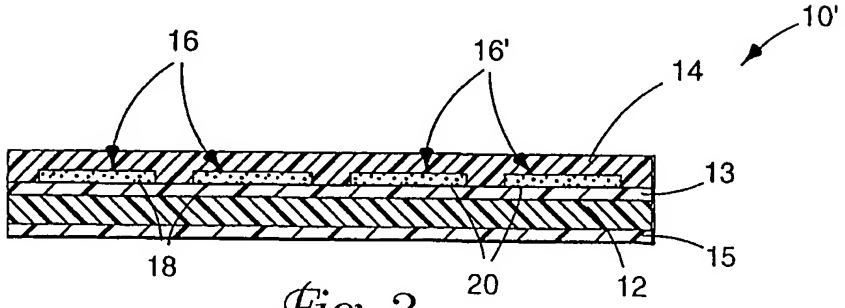

Fig. 3

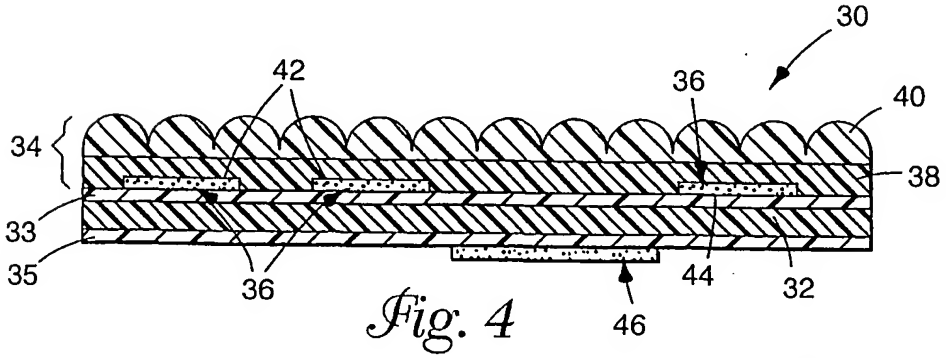

Fig. 4

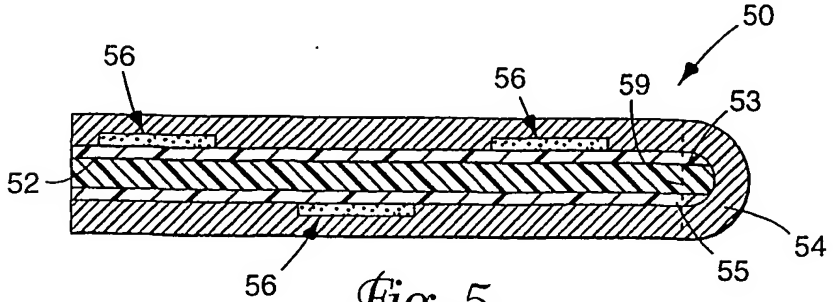

Fig. 5

INTERNATIONAL SEARCH REPORT

Ir onal Application No
PCT/US 00/25034

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B27/36 C08L67/02 //(C08L67/02,67:02)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0 437 942 A (ICI PLC) 24 July 1991 (1991-07-24) claims 1-10	1,3,10, 11

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 January 2001	24/01/2001

Name and mailing address of the ISA	Authorized officer
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